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Associations between maternal social capital and infant birth weight in three developing countries: a cross-sectional multilevel analysis of Young Lives data

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ABSTRACT

Objective To explore how three indicators of social capital (ie, group membership, social support and cognitive social capital and specific types within each type) are associated with infant birth weight.

Study design and settings Cross-sectional analyses of the first wave of Young Lives Survey data collected in 2002 from India (Andhra Pradesh state), Peru and Vietnam.

Participants 807 mothers in India, 1528 mothers in Peru and 1706 mothers in Vietnam.

Outcomes measure Infant birth weight was measured in grams. Participation in specific groups, receipt of social support from specific groups or individuals and perceptions of their community were measured for social capital indicators. Two-level random intercept linear regression models were fit separately by country (first level: individual and second level: community).

Results Maternal group membership displayed a consistent positive association with infant birth weight across the three countries. There was no relationship with maternal cognitive social capital. Membership in a women's group was associated with infant birth weight consistently in all three countries (b=119.6, 95% CI 21.7 to 217.4 in India, b=133.4, 95% CI 40.9 to 225.9 in Peru, b=60.6, 95% CI 0.5 to 120.6 in Vietnam). However, membership in a political group in Peru was inversely associated with infant birth weight (b=−276.1, 95% CI −465.7 to −86.5).

Conclusion Although a higher level of social capital is associated with higher infant birth weight, specific types of social capital may have different associations with infant birth weight depending on the social, political or cultural specificity of the country. These results pave the way for additional research on the mechanisms through which social capital influences birth weight outcomes in each country.

Strengths and limitations of this study

- This study comprehensively explored the mutually adjusted associations between three dimensions of maternal social capital and infant birth weight across multiple low-income and middle-income countries (LMICs): India, Peru and Vietnam.
- The relationships between infant birth weight and specific components of social group membership and social support were further assessed.
- Data represented randomly sampled mothers and children across Peru and Vietnam and across the state of Andhra Pradesh in India with an oversampling of poor sites.
- The study design is cross-sectional so causality cannot be inferred between social capital and infant birth weight.
- Maternal clinical data were not available, which may lead to omitted variable bias. Data are more than 15 years old. However, our message is still valid and can give lessons to other LMICs that are currently going through similar contexts.

INTRODUCTION

Infants born with low birth weight are more likely to have disabilities and be hospitalised,[1] or display intellectual impairment.[1 2] These challenges have been linked to lower socioeconomic status (SES) and chronic diseases later in life.[3] In addition, most low birth weight babies require high-cost intensive care technology right after birth as well as continuous medical care, causing a substantial economic burden to society.[4 5]

Many studies over the last few decades focusing on factors associated with low birth weight have found that the determinants of low birth weight are multifactorial.[6] For example, intrauterine growth restriction due to congenital anomalies[7] and environmental factors (eg, exposure to tobacco smoking or environmental toxins) cause low birth weight.[8 9] SES and health behaviours such as smoking, alcohol consumption and missing prenatal care have also been associated with low infant birth weight.[10–12] In addition, social capital has been identified as an important correlate of pregnancy and infant health outcomes even after adjusting for socioeconomic characteristics.[13–16] These factors are not necessarily mutually exclusive as one

factor may influence infant birth weight either directly or indirectly through another factor.[17]

Public health research has generally conceptualised the term social capital in two ways.[18] 'Social-cohesion' school of thought presents social capital as a group-level attribute of an organisation or a community, as opposed to a description of individual members who belong to the group.[19–21] They recognise social capital as a functional dimension generated from the social structure of society, communities or neighbourhoods, while social supports are different functional dimension generated from a social network of individual actors within the social structure[20] Another school of thought, 'network' theory of social capital' defines social capital in terms of the resources embedded within whole social networks. Under this framework, social capital can be assessed as both an individual attribute as well as a property of the collective.[22–24] Individual-level attributes of social capital can be measured as an individual's access to instrumental, emotional or financial support within a social network, and group-level attributes of social capital, named 'cognitive social capital', can be measured as collective norms, attitudes, beliefs and values.

Technically, network structure could be described as a structural factor that generates social support and social capital rather than being categorised itself as social capital.[20] However, network structure is also used as a measure of social capital by some researchers,[25] for example, as a count of connections to individuals and groups or the strength of those connections. Specifically, a stronger or larger social network can provide pregnant mothers with access to information in addition to being associated with higher cognitive social capital as well as social support.[16] Our study adopted the 'network' analyst view on the conceptualisation of social capital with social network being included as social capital.

The mechanisms linking maternal social support and infant health have been relatively well established in previous studies. Maternal social support operates directly by motivating the mother to engage in positive health behaviours via knowledge transfer or receipt of financial aid from the social supports.[26] It can also affect infant health indirectly by buffering against stressful life transitions.[27–29] Another possible explanation is that social support stimulates beneficial neuroendocrine responses.[30] In addition, feelings of security and self-esteem produced through high cognitive social capital may affect pregnancy outcomes by reducing mental stress or adjusting health behaviours.[31 32] However, most prior studies have focused on either only one of dimension of social capital or have aggregated the different dimensions of social capital into one index,[14 33] despite other studies emphasising the importance of separating the dimensions of social capital.[22 34]In addition, most of this research was based in high-income countries, such as the UK,[35] USA[36–38] and the Netherlands.[14]

Another missing point in previous studies is that they either focused on only one specific type of social capital or used composite score,[14 33] although each type of social network or social support may play a different role in infant birth outcomes. None has comprehensively assessed the differential associations that specific types of social capital may exhibit with infant birth weight.

To address these gaps in the literature, this study aimed to: (1) explore the associations between infant birth weight and level of maternal social network, cognitive social capital and social support and (2) explore the association between different types of social capital and infant birth weight in three low-income or middle-income countries (India, Peru and Vietnam). We hypothesised each of the three dimensions of social capital individual mothers have would be positively associated with infant birth weight but that the specific types in each dimension of social capital will exhibit different pattern of the associations with infant birth weight.

METHODS

Data source

Data were obtained from an international and longitudinal survey named 'Young Lives study'.[39] The Young Lives study is composed of two cohort groups. The 'younger cohort' representing 2011, 2052 and 2002 children aged 6–18 months in 2002 (representing the first wave of data) in India, Peru and Vietnam, respectively. Although more recent waves of data were collected, this study uses the data from 2002 because that first round is when infant birth weight was recorded and when the maternal social capital assessments were most temporally close to infant birth weight compared with more recent rounds of data collection.

The Young Lives study employed a clustered sampling strategy with a semipurposive sampling of 20 sentinel sites in each country to represent a range of regions, policy contexts and living conditions with oversampling of poor sites to serve the study objective, which is to study the causes and consequences of childhood poverty.[39] All households with children aged between 6 months and 18 months within the sites were listed, and then 100 households from each site were randomly selected for the survey.[40] More information on the sampling strategies in each country can be found elsewhere.[41] Households that refused to participate—less than 2% of the selected households—were replaced with other households from the list. The response rate was above 90% in all the countries. Data were collected by a standardised, interviewer-administered questionnaire from the child's main caregiver. All interviewers received training based on common guidelines.

After excluding 'non-biological mothers' and 'missing' and 'don't know' responses in the outcome and independent variables, the number of respondents in the final analytic sample was 807 mother/child pairs residing in 95 communities in India, 1528 pairs in 82 communities in Peru and 1706 pairs in 31 communities in Vietnam (figure 1). Demographic and socioeconomic comparisons

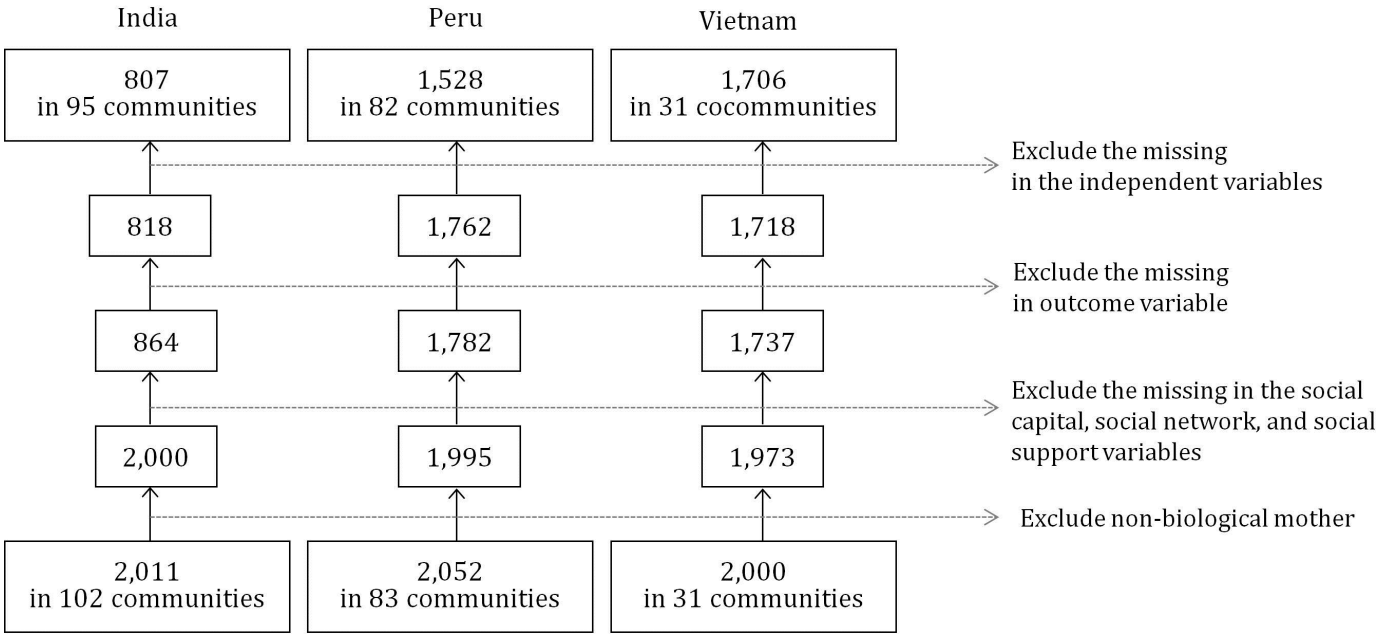

Figure 1 Flow chart of the final analytical sample sizes for India, Peru and Vietnam.

between the final analytic sample and the original sample are provided in online supplementary table 1.

Outcome and social capital variables

The outcome variable of the study was infant birth weight measured in grams and used as a continuous variable in the main analyses.[42] Low infant birth weight was defined by WHO criteria (<2500 g).[43] Hospital, clinic or maternity home documents were used as the data source for infant birth weight where possible. If caretakers did not have these records, maternal recall was used to obtain infant birth weight.[44] Studies have found that mothers in developing countries can recall birth weights accurately if the information was obtained at as early an age as possible.[44–46]

The Young Lives study used the Short Social Capital Assessment Tool (SASCAT) to quantitatively measure social capital. The tool was evaluated for construct validity in Vietnam and Peru using a range of methods, including factor analysis and qualitative cognitive interviews.[34 47] SASCAT is a shortened version of the Adapted Social Capital Tool developed by Harpham *et al*.[48] It measures three dimensions of network-based social capital at the individual level, that is, group membership, cognitive social capital and social support. Level of group membership, cognitive social capital and social support were operationalised with a similar approach used in the previous studies.[49] Specifically, a total score of group membership was generated by summing the number of groups in which a mother was a member (yes/no). The maximum was seven group including work related/trade union group, community association or cooperative group, women's group, political group, religious group, credit or funeral group and sports group. The score was then categorised as none of the groups, membership in one group and membership in more than two groups.

Cognitive social capital was calculated by summing the number of 'yes' responses to three questions about a sense of belonging, mutual trust and getting along with each other in respondent's community and adding 1 for a 'no' response to another question related to unfavourable perception (whether there are people in your community trying to take advantage of you). Thus, the range of the score was 0–4. As we assumed that the effect of maternal cognitive social capital would not present linearly, we grouped the score into three categories: low (0–1), medium (2–3) and high (4).

Finally, information about support received from groups in which respondents were members as well as information about social support received from specific types of individuals were combined to measure social support. If respondents responded affirmatively that they had a membership in a certain group, they were asked whether they had received support from that group in the previous year. In addition, respondent were asked whether they had received support from each of nine categories of individuals (eg, family, neighbours, friends, community leaders, politicians and so on). Thus, a total score of social support was calculated by adding the number of 'yes' responses to all of these questions. The possible score ranged from 0 to 16 and was then categorised as 'never received support', 'received support from 1 to 2 groups or individuals' and 'received support from 3+groups or individuals'. Cut-offs for categorisation were determined based on the frequency distribution. The same cut-offs were used in each country. The list of questions about each dimension of social capital is presented in online supplementary table 2.

Other explanatory factors

The selection of other explanatory factors to be included in this study was guided by a review of previous

articles.[16 30 35 37] Mother's age at pregnancy was divided into 10-year intervals: younger than 19, 20–29 years, 30–39 years and older than 40 years. Mother's education was grouped into four categories: below primary (lowest), primary school (low), middle school (medium) and high school or above (high). Household wealth quintiles were calculated using information on 30 assets and housing characteristics and conducting a principal components analysis.[50] Categorisation of ethnicity depended on the country. In India, categories included other castes (ethnic majority), backward caste, scheduled tribe and scheduled caste. In Peru, categories included Mestizo (ethnic majority) or other. In Vietnam, categories included Kinh (ethnic majority) and non-Kinh. Marital status was dichotomised into married and single, with the latter including divorced or separated, single and widowed. Antenatal care (at least one visit vs no visit), parity of child (first vs second or more) and infant sex were also recorded. All factors were also measured at individual level.

Statistical analysis

A two-level random intercept linear regression model was used to estimate the associations between maternal group membership, cognitive social capital and social support and infant birth weight for each country. We chose to use linear regression by operationalising birth weight as a continuous variable (rather than use logistic regression based on a binary outcome variable) because previous work has shown that the effect of social capital on health might be relatively small[32] and we wanted to detect any small differences in infant birth weight among different levels of social capital. In addition, there was a non-convergence issue that might be caused by a small number of observations in a few categories for certain independent variables.

The first level of the model represented the individual (i) and the second level represented the community (j) as defined by local administrative boundaries. The model specified as follows:

$$Y_{ij} = \beta_{0j} + BX'_{ij} + R_{ij}$$
$$\beta_{0j} = \gamma_{00} + U_{0j}$$

This model estimates the Y_{ij} when adjusted for a vector (X'_{ij}) of the aforementioned independent variables measured at an individual level. β_{0j} indicates average intercept (γ_{00}) plus community-dependent deviation (U_{oj}). First, we examined the association between categories of group membership, cognitive social capital social support and birth weight. Considering that group membership, cognitive social capital and social support are conceptually distinct and that mean variance inflation factors were below two across the social capital indicators, we assumed that there was no problematic level of multicollinearity. Therefore, the model included all three indicators. Then, associations between specific types of group membership, social support and birth weight were investigated. Collinearity was detected between specific types of group membership and specific types of social support. Therefore, we included types of group membership and types of social support in separate models. All models accounted for sociodemographic factors.

Multilevel models assume that the distribution at each level comes from am multivariate Gaussian distribution.[51] We produced a normal score plot to assess this assumption, which showed that the data at each level were normally distributed for all three countries (online supplementary figure 1) . All analyses were carried out by MlwiN 3.02.

Patient and public involvement

This study did not involve patients. Participants were households that have children aged between 6 months and 18 months at the time of recruitment in 2002. The findings from this study will be disseminated to the public via local media and civil society organisations.

Results

Table 1 presents the frequency of respondents and mean birth weight according to the categories of infant and maternal characteristics in three countries. Five hundred and sixteen and 1074 mothers in India and Vietnam, which corresponds to more than 60% of the sample in each country, and 802 mothers, which is more than 50% of the sample in Peru, were 20–29 years old when they were pregnant. Seven hundred and twenty-two, 1447 and 1517 mothers (about 90% of the sample) received antenatal care during pregnancy in India, Peru and Vietnam, respectively. The distribution of education level is not consistent across countries. The mean infant birth weight from the Indian sample was lower than average birth weight from the other two countries, and the prevalence of low birth weight was also the highest in Indian sample.

Table 2 describes patterns of group membership, cognitive social capital and social support and mean infant birth weight for each country. The level of cognitive social capital, particularly the level of mutual trust and sense of belonging, were low in Peru compared with the other two countries. The proportion of women with membership in the women's group and women who received support from it was also lower in Peru than in India or Vietnam ($p<0.0001$). None of the women in India had membership in a credit or funeral group nor in a sports group. Mean infant birth weight showed a statistically significant gradient according to the level of group membership in all three countries ($p<0.0001$).

Table 3 displays the associations between group membership, cognitive social capital and social support and infant birth weight from the adjusted multilevel regression model. Infant birth weight was positively associated with group membership in all three countries. In contrast, there was no association with cognitive social capital in all countries. A statistically significant association was found between social support and infant birth weight only in Vietnam.

Table 1 Descriptive statistics of study samples from India, Peru and Vietnam and average infant birth weight (in grams)

	India		Peru		Vietnam	
Variable	**N (%)**	**Mean birth weight (SD)**	**N (%)**	**Mean birth weight (SD)**	**N (%)**	**Mean birth weight (SD)**
Mother's age at pregnancy (years)						
≤19	257 (31.9)	1. 2720 (557)	341 (22.3)	3120 (487)	195 (11.4)	2968 (406)
20≤ and <30	513 (63.4)	2783 (538)	802 (52.5)	3224 (501)	1074 (62.9)	3099 (432)
30≤ and <40	37 (4.6)	2. 2758 (611)	335 (21.9)	3224 (505)	408 (23.9)	3177 (432)
40+ years	1 (0.1)	3000 (-)	50 (3.3)	3022 (592)	29 (1.7)	3117 (483)
Antenatal care						
No	85 (10.5)	2835 (531)	81 (5.3)	3013 (602)	189 (11.1)	3047 (470)
Yes	722 (89.5)	2754 (549)	1447 (94.7)	3205 (497)	1517 (88.9)	3111 (442)
Mother's education						
Below primary	336 (41.6)	2704 (548)	111 (7.3)	2983 (416)	345 (20.2)	3046 (469)
Primary	65 (8.1)	2708 (641)	3 (0.2)	3017 (500)	688 (40.3)	3079 (424)
Middle	89 (11.0)	2792 (564)	1152 (75.4)	3190 (504)	557 (32.6)	3151 (451)
High or above	317 (39.3)	2827 (516)	262 (17.1)	3304 (513)	116 (6.8)	3194 (435)
Parity						
Second or more	805 (99.8)	2762 (547)	Not available		1701 (99.7)	3104 (446)
First	2 (0.2)	3000 (707)			5 (0.3)	2940 (288)
Marital status						
Single	7 (0.9)	2643 (537)	227 (14.9)	3062 (515)	38 (2.2)	3021 (435)
Married	800 (99.1)	2764 (548)	1301 (85.1)	3217 (499)	1668 (97.8)	3105 (445)
Wealth status						
The lowest	161 (20.0)	2616 (433)	311 (20.4)	3070 (511)	339 (19.9)	3011 (451)
Low	161 (20.0)	2789 (643)	312 (20.4)	3133 (528)	347 (20.3)	3090 (450)
Moderate	161 (20.0)	2749 (619)	296 (19.4)	3246 (486)	340 (19.9)	3110 (446)
High	161 (20.0)	2780 (498)	310 (20.3)	3239 (462)	336 (19.7)	3117 (450)
The highest	163 (20.2)	2876(488)	299 (19.6)	3290 (503)	344 (20.2)	3188 (412)
Infant gender						
Male	438 (54.3)	2793 (560)	768 (50.3)	3223 (513)	883 (51.8)	3151 (460)
Female	369 (45.7)	2727 (531)	760 (49.7)	3166 (494)	823 (48.2)	3052 (423)
Ethnicity (India)						
Other castes	254 (31.5)	2845 (551)	Not applicable		Not applicable	
Backward caste	361 (44.7)	2737 (556)				
Scheduled tribe	84 (10.4)	2624 (374)				
Scheduled caste	108 (13.4)	2760 (599)				
Ethnicity (Peru)						
Mestizo	Not applicable		1401 (91.7)	3194 (501)	Not applicable	
Others*			127 (8.3)	3197 (544)		
Ethnicity (Vietnam)						
Kinh	Not applicable		Not applicable		1696 (93.6)	3115 (441)
Non-Kinh					110 (6.4)	2935 (475)
Prevalence of low birth weight	2762 (16.7)		3194 (5.4)		3104 (5.0)	

Table 4 presents the associations between specific types of group membership and specific sources of social support and infant birth weight. Membership in a women's group was positively associated with infant birth weight consistently in all three countries. Additionally, a significant association between membership in a religious group and infant birth weight was found in Indian and Peru. In contrast, membership in a political group was negatively associated with infant birth weight in Peru while no significant association was seen in the other two countries.

Table 2 Distribution of group membership, cognitive social capital and social support and average infant birth weight (in grams) in India, Peru and Vietnam

Variable	India		Peru		Vietnam	
	N (%)	Mean birth weight (SD)	N (%)	Mean birth weight (SD)	N (%)	Mean birth weight (SD)
Social group membership						
Work-related or trade union group	26 (3.2)		5 (0.3)		139 (8.1)	
Community association or cooperative group	24 (3.0)		93 (6.1)		95 (5.6)	
Women's group	162 (20.2)		117 (7.7)*		286 (16.8)	
Political group	14 (1.7)		26 (1.7)		17 (1.0)	
Religious group	4 (0.6)		87 (5.7)		11 (0.6)	
Credit or funeral group	0 (0)		4 (0.3)		113 (6.6)	
Sports group	0 (0)		25 (1.6)		5 (0.3)	
Total number of social group membership						
None of the groups	600 (74.3)	2739 (510)†	1245 (81.5)	3169 (491)†	1238 (72.6)	3081 (445)†
1 group	185 (22.9)	2811 (615)†	224 (14.7)	3277 (532)†	315 (18.5)	3126 (428.)†
2+ groups	22 (2.9)	3000 (854)†	59 (3.9)	3407 (607)†	153 (9.0)	3236 (459)†
Cognitive social capital						
Majority of people can be trusted	764 (94.7)		536 (35.1)		1437 (84.2)	
The majority of people get along	759 (94.1)		1042 (68.2)		1565 (91.7)	
Really feel part of the community	782 (96.9)		244 (16.0)*		1678 (98.4)	
Take advantage of you	322 (39.9)		899 (58.8)		159 (9.3)	
Level of cognitive social capital						
Low (0–1)	20 (2.5)	2675 (639)	343 (22.5)	3221 (513)	50 (2.9)	3016 (500)
Medium (2–3)	350 (43.3)	2751 (524)	855 (56.0)	3212 (510)	337 (19.8)	3106 (418)
High (4)	437 (54.2)	2776 (564)	330 (21.6)	3120 (475)	1319 (77.3)	3106 (450)
Support from group						
Work-related or trade union group	6 (0.7)		3 (0.2)		116 (6.8)	
Community association or cooperative group	11 (1.4)		34 (2.2)		37 (2.2)	
Women's group*	103 (12.9)		46 (3.0)		194 (11.4)	
Political group	5 (0.6)		14 (0.9)		14 (0.8)	
Religious group	2 (0.3)		64 (4.2)		8 (0.5)	
Credit or funeral group	0 (0)		3 (0.2)		64 (3.8)	
Sports group	0 (0)		10 (0.7)		5 (0.3)	
Support from individual						
Family	564 (69.9)		972 (63.6)		1,62 3 (95.1)	
Neighbours	376 (46.5)		281 (18.4)		1332 (78.1)	
Friends	134 (16.6)		280 (18.3)		1229 (72.0)	
Community leaders	22 (2.7)		29 (1.9)		257 (15.1)	
Religious leaders	5 (0.6)		123 (8.1)		21 (1.2)	
Political leaders	11 (1.4)		13 (0.9)		2 (0.1)	
Government officials	24 (3.0)		73 (4.8)		85 (5.0)	

Continued

Table 2 Continued

Variable	India N (%)	India Mean birth weight (SD)	Peru N (%)	Peru Mean birth weight (SD)	Vietnam N (%)	Vietnam Mean birth weight (SD)
Non Government Organizations charities	13 (1.6)		87 (5.7)		103 (6.0)	
Total number of supports received						
Never received	170 (21.0)	2739 (576)	459 (30.0)	3161 (532)	52 (3.0)	2852 (571)
Support from 1 to 2 groups or individuals	475 (58.9)	2772 (521)	810 (53.0)	3206 (486)	447 (26.2)	3132 (454)
Support from 3+ groups or individuals	162 (20.1)	2758 (600)	259 (17.0)	3219 (509)	1207 (70.8)	3104 (433)

*Significant difference in proportion between countries at p<0.0001 in a χ^2 test.
†Significant difference in mean birth weight between levels of group membership at p<0.0001 in a χ^2 test.
NGO, Non Government Organisatios.

Findings about associations between specific sources of social support and infant birth weight were mixed. Support from a religious group showed a strong positive association with infant birth weight in India and Peru, while it was negatively associated with infant birth weight in Vietnam. Support from a community association, from a cooperative group and from a religious group were positively associated with infant birth weight in Peru only. Support from family was positively associated with infant birth weight in Vietnam only.

The associations between infant birth weight and other potential factors such as maternal age at pregnancy, receipt of antenatal care, marital status and education varied across countries. However, wealth status exhibited a robust positive gradient with infant birth weight in all three countries. This was extracted from models presented in model 3 that examined the association between the composite score of social capital and birth weight (online supplementary table 3).

Discussion

This study examined associations between maternal social group membership, cognitive social capital and social support and infant birth weight and also investigated how different types of group membership and different sources of social support were associated with infant birth weight in three LMICs. A few findings should be emphasised.

First, overall level of maternal social group membership and infant birth weight was consistently associated with infant birth weight in a positive direction for all three countries. In contrast, the association between cognitive

Table 3 Associations between maternal group membership, cognitive social capital and social support and infant birth weight in India, Peru and Vietnam

Variable	India b	India (SE)	India P value	Peru b	Peru (SE)	Peru P value	Vietnam b	Vietnam (SE)	Vietnam P value
Social group membership (ref=none)									
1 group	89.2	(48.5)	0.066	105.4	(36.4)	0.004	41.8	(28.3)	0.139
2+ groups	276.3	(118.5)	0.020	233.5	(67.4)	0.001	120.0	(39.2)	0.002
Cognitive social capital (ref=low)									
Medium	74.7	(125.2)	0.501	17.2	(31.7)	0.587	58.4	(66.3)	0.379
High	108.6	(125.1)	0.337	−71.3	(38.2)	0.062	69.2	(63.3)	0.274
Social support (ref=never received)									
Support from 1 to 2 groups or individuals	57.1	(51.5)	0.267	14.0	(29.1)	0.63	263.5	(64.1)	<0.001
Support from 3+ groups or individuals	−6.5	(65.9)	0.921	5.7	(39.6)	0.886	206.4	(62.7)	0.001

All dimensions of social capital were included together in a model.
The model was adjusted for maternal age at pregnancy, maternal education level, household wealth level, ethnicity, marital status, parity, antenatal care and infant gender.

Table 4 Associations between specific types of group membership and sources of social support and infant birth weight in India, Peru and Vietnam

	India						Peru						Vietnam					
	Model 1			Model 2			Model 1			Model 2			Model 1			Model 2		
	b	(SE)	P value	b	(SE)	P value	b	(SE)	P value	b	(SE)	P value	b	(SE)	P value	b	(SE)	P value
Member in ~ (ref: not a member)																		
Work related/trade union group	119.0	(110.2)	0.280				113.5	(226.1)	0.616				19.7	(46.7)	0.674			
Community association or co-op group	18.0	(113.5)	0.874				244.1	7 (53.4)	<0.001				52.3	(51.1)	0.305			
Women's group	119.6	(49.9)	0.017				133.4	(47.2)	0.005				60.6	(30.6)	0.048			
Political group	117.1	(145.2)	0.420				−276.1	(96.7)	0.004				70.3	(115.2)	0.526			
Religious group	918.1	(266.4)	0.001				179.4	(54.3)	0.001				−106.0	(131.6)	0.420			
Credit or funeral group	–		–				421.0	(248.2)	0.090				51.1	(43.2)	0.238			
Sports group	–		–				−150.7	(101.6)	0.138				−151.5	(206.0)	0.462			
Support from ~ (ref: no support received)																		
Work related/trade union group				−131.5	(222.9)	0.555				−47.9	(308.3)	0.876				54.2	(54.5)	0.320
Community association or co-op group				55.1	(168.7)	0.744				248.6	(87.4)	0.004				2.1	(77.6)	0.979
Women's group				85.7	(59.5)	0.150				121.3	(73.7)	0.100				43.0	(38.7)	0.267
Political group				83.2	(253.7)	0.743				−161.5	(146.3)	0.270				6.0	(129.1)	0.963
Religious group				1088.7	(418.7)	0.009				237.2	(71.3)	0.001				−388.1	(197.1)	0.049
Credit or funeral group				–		–				399.8	(301.5)	0.185				23.5	(60.4)	0.697
Sports group				–		–				9.5	(161.2)	0.953				−96.0	(208.8)	0.646
Family				−13.2	(49.3)	0.788				9.0	(28.9)	0.756				131.8	(53.6)	0.014
Neighbourhood				−19.7	(45.7)	0.667				−41.0	(35.9)	0.254				−28.0	(31.1)	0.367
Friends				53.0	(56.7)	0.350				−17.9	(36.3)	0.622				−22.1	(28.9)	0.445
Community leaders				30.6	(138.9)	0.826				74.7	(96.7)	0.440				35.7	(31.3)	0.255
Religious leaders				−309.1	(328.6)	0.347				57.2	(53.1)	0.281				209.9	(124.3)	0.091
Politicians				110.3	(209.9)	0.599				−115.3	(159.8)	0.470				−419.6	(314.5)	0.182
Government officials				−74.3	(126.0)	0.555				66.4	(62.2)	0.286				−110.2	(63.1)	0.081
Charitable organisation or NGO				185.3	(167.1)	0.267				−59.7	(59.3)	0.314				13.8	(47.9)	0.773
Other source				−50.2	(387.7)	0.897				−259.7	(343.2)	0.449				−21.0	(51.6)	0.683

The model was adjusted for maternal age at pregnancy, maternal education level, household wealth level, ethnicity, marital status, parity, antenatal care and infant gender.

social capital and infant birth weight was not statistically significant in all three countries. Current findings are supported by results from previous studies on social capital and birth outcomes. For example, Baker *et al*[15] reported a non-significant association between social cohesion and collective efficacy and low birth weight in India. In Kritsotakis *et al*,[16] feeling of safety and tolerance to diversity were not associated with any of birth outcomes such as preterm birth, small for gestational age, fetal weight growth restriction, fetal weight, fetal length and head circumference. However, studies using measures of cognitive social capital from the Young Lives study have found them to be associated with other child outcomes such as height and mental health.[13] A definitive explanation for this different pattern of association depending on the outcome is lacking. Although De Silva and Harpham[13] suggest that higher cognitive social capital may foster a mother's psychological well-being and ability to cope and, thus, enable them to better care for their child, this cognitive support may not be strong enough to improve care for the fetus during pregnancy. Discrepancies regarding the role of cognitive social capital on infant health needs further research elucidation.

Second, although the overall level of maternal group membership showed a positive gradient with infant birth weight in Peru, membership in a political group showed an inverse association with infant birth weight. Similarly, despite the positive association between the overall level of support and infant birth weight, support from a religious group was negatively associated with infant birth weight in Vietnam. Caution is needed when interpreting these results given the cross-sectional nature of the data and that the number of respondents who were members in a political group and who received support from a religious group were small. However, the downside of social capital is worth discussing. Social capital, usually praised for its benefit, can cut both ways as spheres of responsibility across social groups, local communities, family and neighbours vary according to the social, economic or political context of the society.[52] For example, tightly knit and cohesive communities may lead to exclusion of outsiders, excessive claims made on group members sometimes at a high personal cost or restrictions on individual freedoms.[53 54]

Our result is, in part, in line with a study on birth outcomes in Greece where for every unit increase in maternal group participation, there was an estimated increase in the risk of preterm birth.[16] The authors suggested that more participation may be linked to more exposure to social and/or environmental stressors. A couple of studies have demonstrated the downside of social capital on other outcomes through empirical analyses. De Silva[55] found a significant association between maternal group membership and increased odds of maternal common mental disorder in Andhra Pradesh of India. She suggested that participation in the women's group that is mainly based on microcredit schemes may be stressful to the poor women due to their inability to make a profit using loans from the scheme, thus, not being able to repay the loans. Hurtado *et al*[56] demonstrated a negative association between non-electoral participation in political group and self-rated health in Columbia, presumably due to the effect of political violence. In a study by Mitchell and LaGory,[57] bonding social capital was shown to be positively associated with mental distress in an impoverished and racially segregated urban neighbourhood in the USA.

Peru, as did many other countries in Latin America, introduced democratic governance during the 1980s. However, it has still suffered from long-term political instability and suppression of civil society including suppression of political groups.[58 59] In addition, although there has been increased female empowerment in Peru, men are still more likely to hold positions of power and prestige in political environment, while women carry the burden of implementing chores that is is time-consuming and confer less prestige.[60] It is likely that participating in a political group within a period of oppression combined with the lower status of women within such a group is unfavourable for a pregnant woman's well-being. Analysis based on a larger sample size and qualitative studies are needed to further understand this negative association.

Third, membership in a women's group was consistently associated with higher birth weight in all three countries. Women's groups are a self-organised group who undertake various activities such as skills training to fundraising.[61] This gathering provides important sources for bonding social capital where mothers share information related to health and exchange emotional or material support. Level of adaptation to encouraged health behaviour or amount of shared information obtained is higher through voluntary participation in a social group than through just education because of its nature of the interaction.[62] Although there is some evidence concerning a harmful effect from the extra burden of participating in a women's group,[32 55 60] it may depend on country or community context. Generally, a women's group is expected to have a protective role for birth outcomes through knowledge transfer and information sharing related to pregnancy and delivery during interaction with other members.[63]

The final key finding is that, in Vietnam, support from individuals especially from family may be important for preventing mothers from having low weight babies. This finding is backed up by another study using the same data source, which found a positive association between maternal social support from an informal network and nutritional status of 1-year-old children in Vietnam.[32] The informal network is a strong feature of Vietnamese society to the extent that more than 95% of mothers have received support from family and more than 78% and 72% of mothers have received support from neighbours and friends, respectively, which is much higher compared with informal support levels in India and Peru. Vietnam's Confucian tradition promotes trust in a comparatively narrow realm of family that offers extensive support.[64 65]

This support may influence infant birth weight by provision of emotional care, knowledge about prenatal care or physical and material assistance.[30 32]

Our exploratory analyses provide a comprehensive picture of the associations between maternal social capital indicators and infant birth weight in three very different cultural contexts. This study implies that although some forms of social capital may generally be associated with infant birth weight in a positive direction, specific sources of social capital may have different associations with infant birth weight depending on the social, political or cultural specificity of the country. Results suggest many challenging questions requiring for further research to answer. To tailor a specific intervention for each society, additional research is needed on the detailed mechanisms through which social capital influences birth weight outcomes in each country.

Limitations

This study should be interpreted with care due to several limitations. First, a substantial proportion of observations were excluded due to missings on the dependent variable. However, we did not consider multiple imputation (MI) method because MI cannot improve on complete case analysis when missing happens on the dependent variable with no missing data on any of the independent variables, and there are no strongly correlated auxiliary predictors. Although comparison of descriptive statistics between the dropped sample and the original sample suggest that the missings are random, there still is a chance of bias arising from the missings. Second, the cross-sectional design limits causal inference. It is possible that some of the associations are attributable to reverse causality. For example, healthy pregnant mothers may be more likely to participate in a social group. Third, while infant birth weight could be affected by social capital all the way through the gestational period, the Young Lives study asked about maternal social capital during the last 12 months before the survey time. Some mothers might have started participating in a certain group or receiving support after the baby was born. How this would affect the result can cut both ways. While mothers with a healthy baby may be more likely to attend a social group, it is also possible that mothers with a less healthy baby join a social group to seek help. Fourth, there might be omitted variable bias as we did not have information about maternal health status such as genetic disease or maternal obstetric condition. However, considering that the prevalence of congenital defect is usually low, the effect of this kind of omitted variable bias is assumed to be marginal. Fifth, the data for the study are more than 15 years old, which may lead to questions about whether the associations are still valid within current contexts. However, it is expected that changes in associated factors over time do not harm the validity of the original findings. In addition, the results of our study may offer lessons to other LMIC contexts currently experiencing situations that India, Peru and Vietnam experienced 15 years ago. Sixth, though SASCAT has been validated in Peru and Vietnam, no validation has yet been conducted in Andhra Pradesh. However, the questions about group type or support type are relatively conceptually clear, and therefore, chances are low that people would interpret the questions differently by country. Lastly, Young Lives study adopted oversampling for poor sites, and data from India were drawn only from the state of Andhra Pradesh. Although sample selection was designed in a way that they can provide opportunities to compare poor and better-off by avoiding comprising the sample exclusively of poor children and minimise the chance that the results of the study would be rejected on the grounds of not being representative, care should be given to when discussing the results as applied to the entire population.

CONCLUSION

Results from our study revealed that although the overall level of social capital is positively associated with the birth weight, specific type of membership or social support may play a negative role for infant birth weight within a given cultural context. Policy efforts to strengthen social capital should consider local societal and cultural dynamics to identify a potentially helpful source of social capital. Specific ways of intervening on maternal social capital need to be tailored for each society rather than transplanting interventions from country to country.

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